Fig.1

100

PCB

20

CAMERA
UNIT — 30

40

50

IMAGE DATA

LUT

110
REPRESENTATIVE
COLOR SETTER

120
PRE-PROCESSOR

130
COMPOSITE DISTANCE
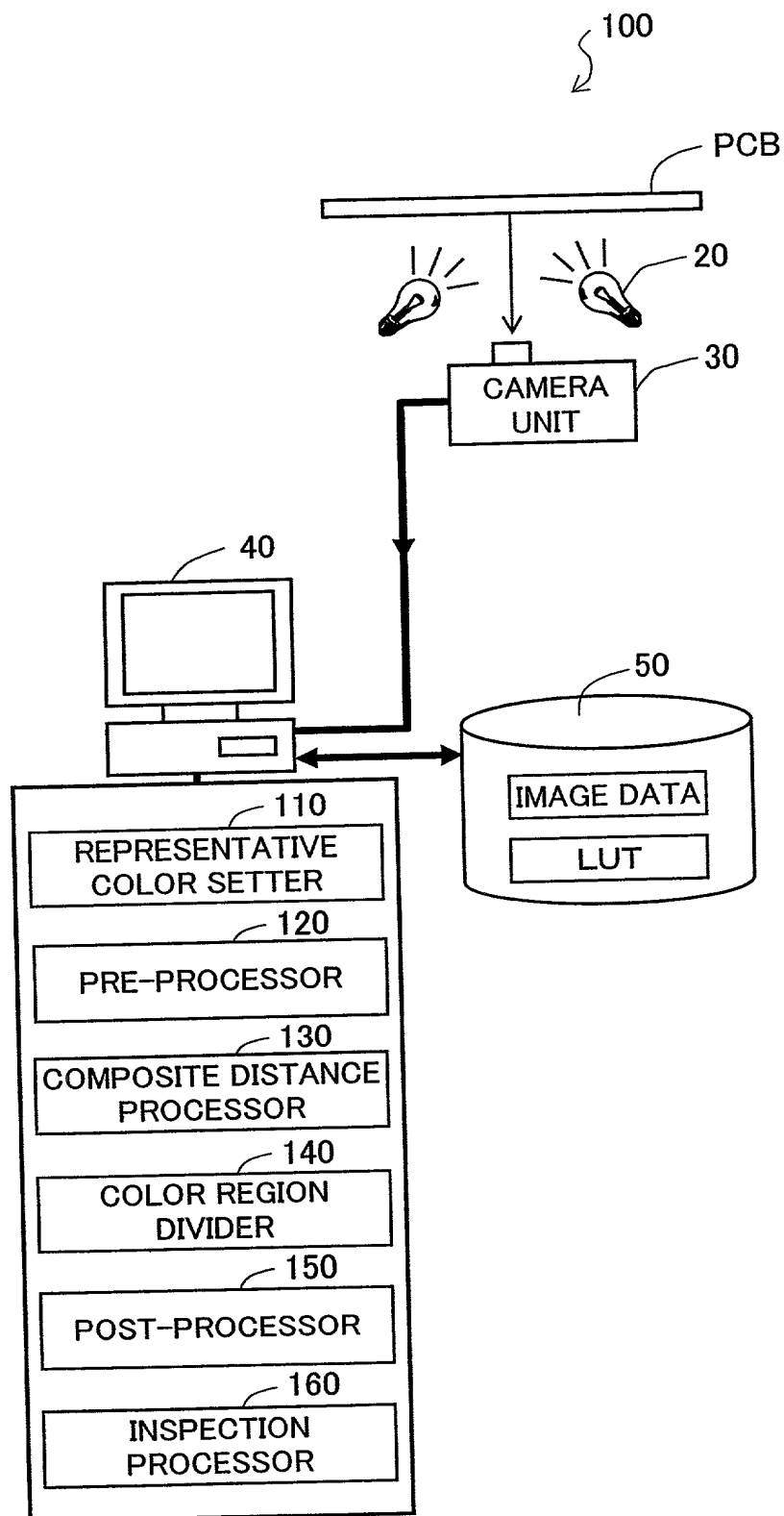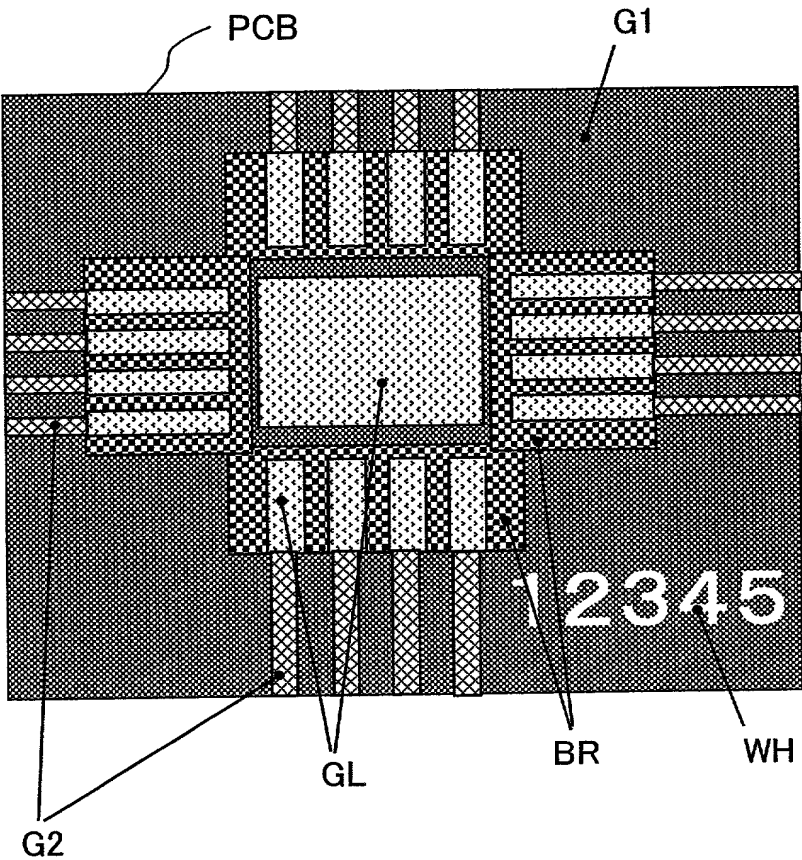PROCESSOR

140
COLOR REGION
DIVIDER

150
POST-PROCESSOR

160
INSPECTION
PROCESSOR

Fig.2

GR {
GREEN REGION G1:   BOARD BASE REGION COATED WITH RESIST
(RESIST REGION WITH LOWER BRIGHTNESS)

GREEN REGION G2:   COPPER WIRINGS REGION COATED WITH RESIST
(RESIST REGION WITH HIGHER BRIGHTNESS)
}

GOLD REGION GL: REGION PLATED WITH GOLD

BROWN REGION BR: REGION OF BOARD BASE

WHITE REGION WH: REGION PRINTED WITH WHITE CHARACTERS
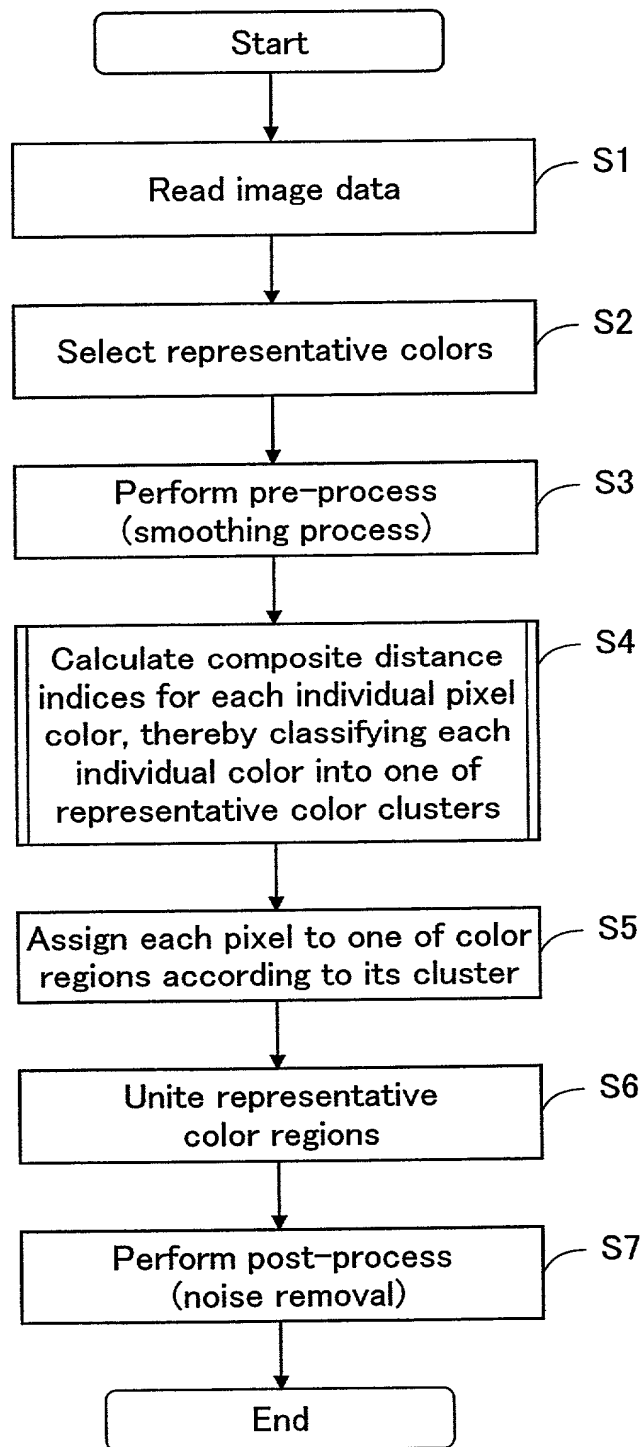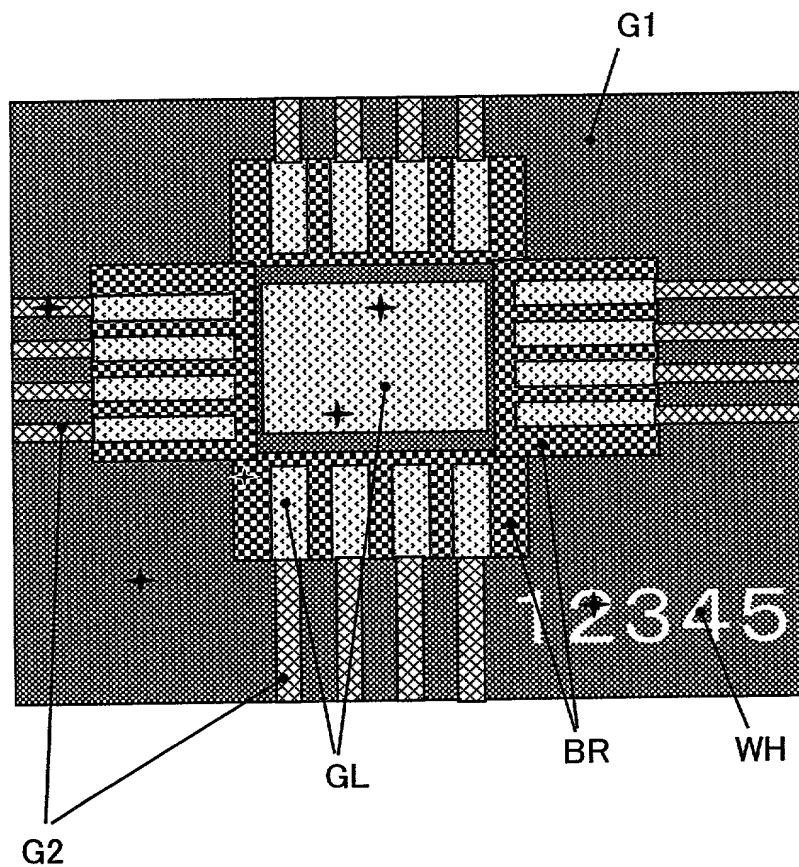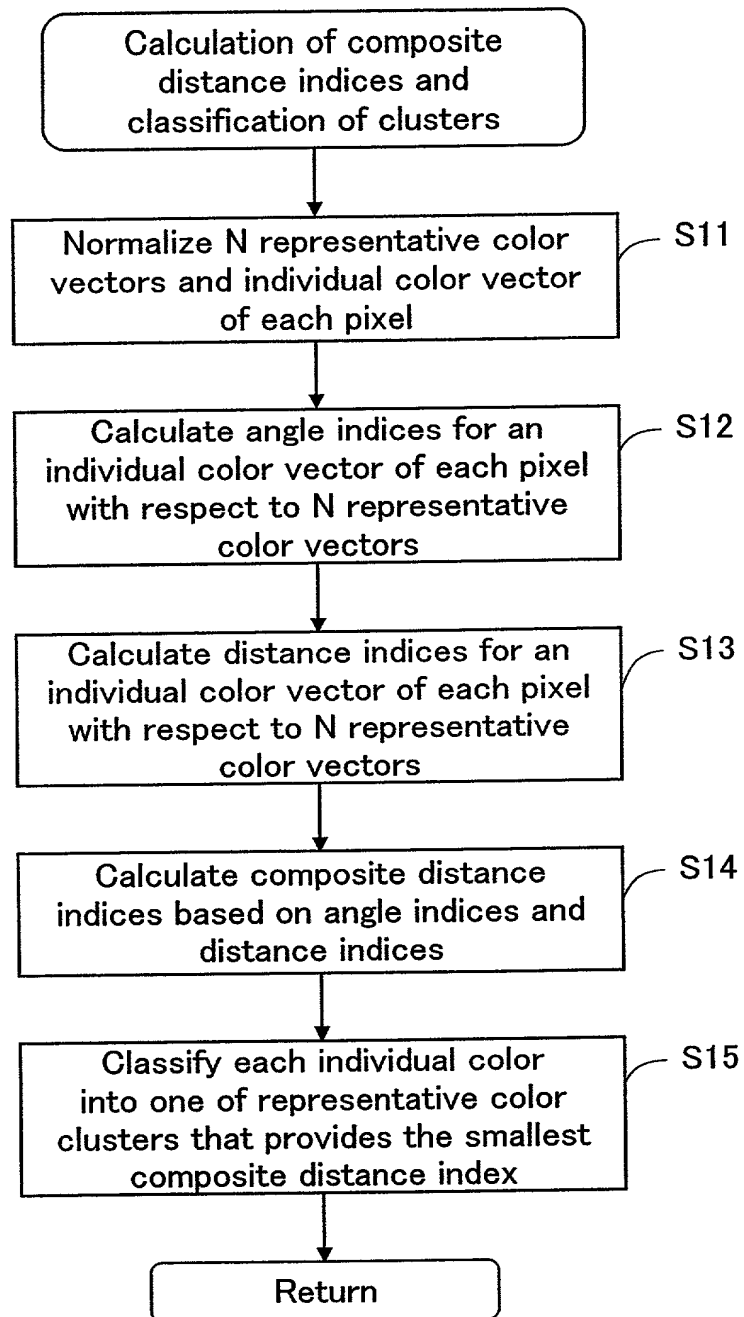
Fig.3

```
        ┌─────────────┐
        │    Start    │
        └──────┬──────┘
               │
        ┌──────▼──────────────┐
        │   Read image data   │──── S1
        └──────┬──────────────┘
               │
        ┌──────▼──────────────────┐
        │ Select representative    │──── S2
        │ colors                   │
        └──────┬──────────────────┘
               │
        ┌──────▼──────────────────┐
        │  Perform pre-process     │──── S3
        │  (smoothing process)     │
        └──────┬──────────────────┘
               │
        ┌──────▼──────────────────────┐
        │ Calculate composite distance │──── S4
        │ indices for each individual  │
        │ pixel color, thereby         │
        │ classifying each individual  │
        │ color into one of            │
        │ representative color clusters│
        └──────┬──────────────────────┘
               │
        ┌──────▼──────────────────────┐
        │ Assign each pixel to one of  │──── S5
        │ color regions according to   │
        │ its cluster                  │
        └──────┬──────────────────────┘
               │
        ┌──────▼──────────────────┐
        │  Unite representative    │──── S6
        │  color regions           │
        └──────┬──────────────────┘
               │
        ┌──────▼──────────────────┐
        │  Perform post-process    │──── S7
        │  (noise removal)         │
        └──────┬──────────────────┘
               │
        ┌──────▼──────┐
        │     End     │
        └─────────────┘
```
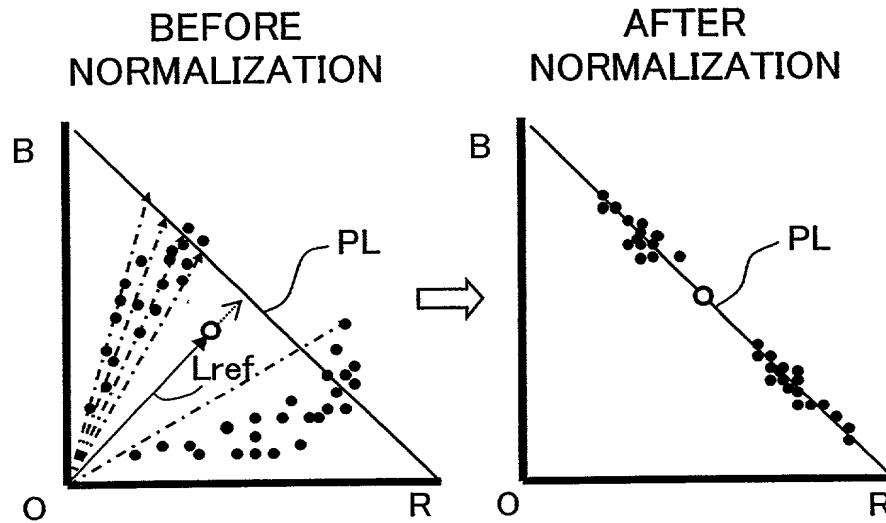
Fig.4

G1

G2

GL

BR

WH

+ : SAMPLE POINT

FIRST DIVIDED REGION DR1 { GREEN REGION GR { G1 / G2 }

SECOND DIVIDED REGION DR2 { GOLD REGION GL / BROWN REGION BR }
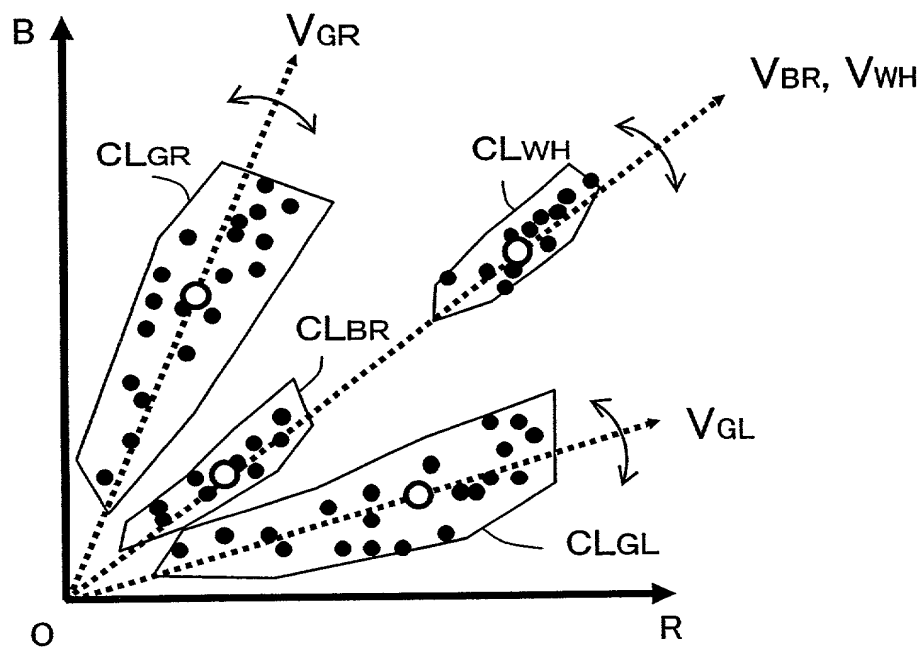
THIRD DIVIDED REGION DR3 { WHITE REGION WH

Fig.5

```
┌─────────────────────────────┐
│   Calculation of composite  │
│       distance indices and  │
│    classification of clusters│
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   Normalize N representative │ ─── S11
│  color vectors and individual│
│        color vector          │
│        of each pixel         │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   Calculate angle indices for an │ ─── S12
│ individual color vector of each pixel│
│   with respect to N representative   │
│          color vectors           │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│  Calculate distance indices for an │ ─── S13
│ individual color vector of each pixel│
│   with respect to N representative   │
│          color vectors           │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   Calculate composite distance  │ ─── S14
│   indices based on angle indices and│
│          distance indices        │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│    Classify each individual color  │ ─── S15
│   into one of representative color  │
│  clusters that provides the smallest │
│      composite distance index      │
└─────────────────────────────┘
              │
              ▼
        ┌──────────────┐
        │    Return    │
        └──────────────┘
```

Fig.6A

BEFORE NORMALIZATION

Fig.6B

AFTER NORMALIZATION

o : REPRESENTATIVE COLOR
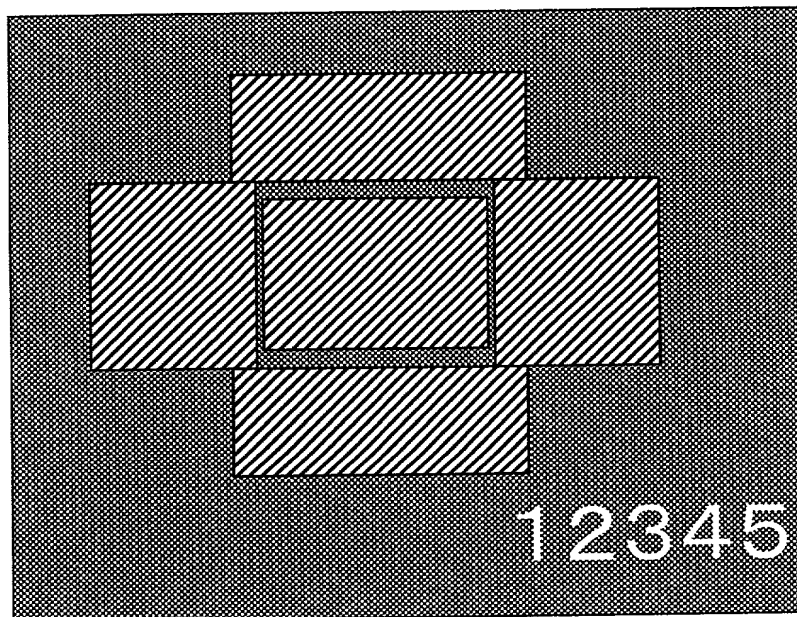
● : INDIVIDUAL COLOR

Fig.7

C L G R : GREEN CLUSTER   V G R : GREEN REPRESENTATIVE VECTOR

C L G L : GOLD CLUSTER   V G L : GOLD REPRESENTATIVE VECTOR

C L B R : BROWN CLUSTER   V B R : BROWN REPRESENTATIVE VECTOR

C L W H : WHITE CLUSTER   V W H : WHITE REPRESENTATIVE VECTOR
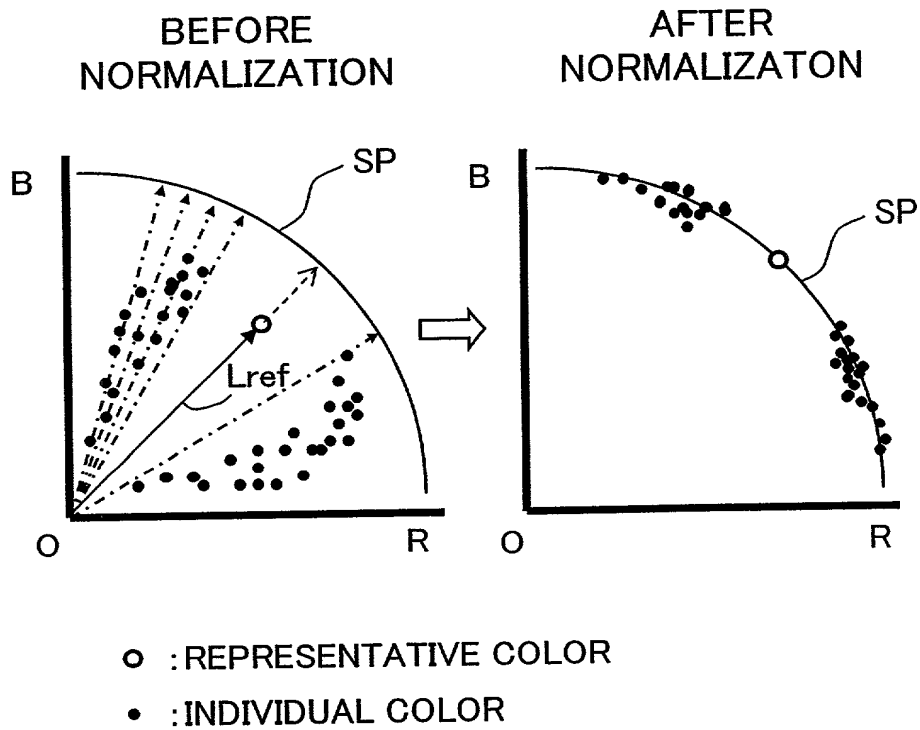
○ : REPRESENTATIVE COLOR

● : INDIVIDUAL COLOR

Fig.8

:FIRST DIVIDED REGION DR1 (G1+G2)

:SECOND DIVIDED REGION DR2 (GL+BR)

:THIRD DIVIDED REGION DR3 (WH)

Fig.9A

Fig.9B

BEFORE NORMALIZATION

AFTER NORMALIZATON
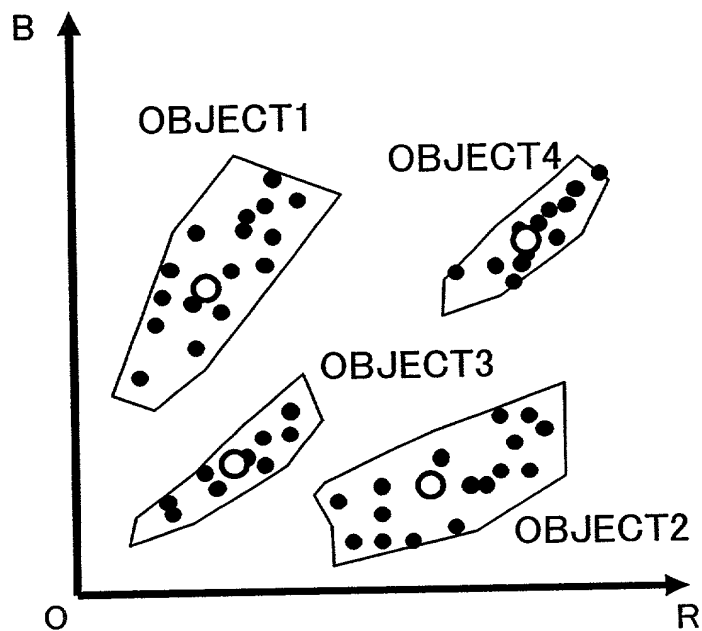

o : REPRESENTATIVE COLOR

● : INDIVIDUAL COLOR

Fig.10A

APPROPRIATE CLUSTERING

Fig.10B

INAPPROPRIATE CLUSTERING